

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2002-134905

(43)Date of publication of application : 10.05.2002

(51)Int.Cl.

H05K 3/34  
B23K 1/00  
B23K 1/008  
// B23K101:42

(21)Application number : 2000-279533

(71)Applicant : YOKOTA TECHNICA:KK

(22)Date of filing : 14.09.2000

(72)Inventor : YOKOTA HACHIJI

(30)Priority

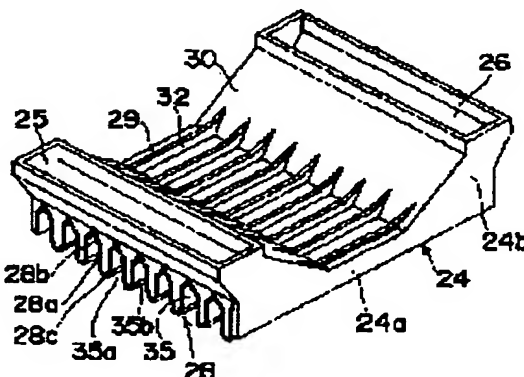
Priority number : 2000245501 Priority date : 14.08.2000 Priority country : JP

## (54) REFLOW SOLDERING DEVICE

(57)Abstract:

**PROBLEM TO BE SOLVED:** To provide a reflow soldering device which smoothenes the flow of the hot air so as to make uniform the temperature distribution of a printed board mounted with an electronic component.

**SOLUTION:** A reflow soldering device is constituted in a structure that the hot air is blown on a printed board mounted with an electronic component in a heating furnace while the printed board is transferred on a conveyer chain. A plurality of air ducts 35 having each opening 35a for making the hot air flow in the heating furnace on the sides of the furnace which face the board are provided on the surfaces, which oppose the board, of the furnace at intervals in the transfer direction of the chain and these air ducts 35 respectively have a first passage that the hot air in the air duct 35 flows from an opening formed in the intermediate part of the air duct 35 to a fan and a second passage that the hot air in the air duct 35 flows from openings 35b formed in both end surfaces of the air duct 35 to the fan.



## LEGAL STATUS

[Date of request for examination] 18.09.2000

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number] 3515058

[Date of registration] 23.01.2004

[Number of appeal against examiner's decision  
of rejection]

[Date of requesting appeal against examiner's  
decision of rejection]

[Date of extinction of right]

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CLAIMS

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[Claim(s)]

[Claim 1] In the reflow soldering equipment which solders electronic parts to a substrate using the hot blast through which it circulates while conveying the substrate with which the inside of a heating furnace was carried in electronic part by conveyor. On the field which counters a substrate, in the conveyance direction of a conveyor, the ventilation flue which has opening into which hot blast flows in the side which attends a substrate sets spacing, and are prepared. [ two or more Reflow soldering equipment characterized by having the 1st path which flows to a blower from opening by which the hot blast which flowed into these ventilation flues is formed in the part intermedia of a ventilation flue apart from said opening.

[Claim 2] Reflow soldering equipment according to claim 1 with which hot blast which flowed into said ventilation flue is characterized by having the 2nd path which flows from opening currently formed in the end face of a ventilation flue to a blower.

[Claim 3] Reflow soldering equipment according to claim 1 or 2 characterized by said ventilation flue being a long and slender ventilation flue which crosses in the conveyance direction of a conveyor.

[Claim 4] Reflow soldering equipment according to claim 1, 2, or 3 characterized by preparing the ventilation flue of the hot blast which blows hot blast against a substrate between the ventilation flues where said hot blast flows.

[Claim 5] Reflow soldering equipment according to claim 1, 2, or 3 characterized by preparing the ventilation flue of the hot blast which blows hot blast against a substrate between each ventilation flue where said hot blast flows.

[Claim 6] Reflow soldering equipment according to claim 4 or 5 characterized by the ventilation flue of the hot blast which blows hot blast against a substrate being a long and slender ventilation flue which crosses in the conveyance direction of a conveyor.

[Claim 7] It is reflow soldering equipment according to claim 1 to 6 characterized by being constituted so that a blower may have inhalation opening to both sides which counter, the hot blast passing through said 1st path may be inhaled by one inhalation opening of a blower and the hot blast passing through said 2nd path may be inhaled by inhalation opening of another side of a blower.

[Claim 8] The hot blast which a blower has inhalation opening in the field and the field of an opposite hand by the side of a substrate, and passes along said 1st path. The hot blast which is inhaled by inhalation opening prepared in the field by the side of the substrate of a blower from opening currently formed in the part intermedia of said ventilation flue, and passes along said 2nd path. Reflow soldering equipment according to claim 7 characterized by being constituted so that it may be inhaled from opening currently formed in the end face of said ventilation flue by inhalation opening prepared in the substrate of a blower, and the field of an opposite hand.

[Claim 9] A blower is reflow soldering equipment according to claim 1 to 6 characterized by having inhalation opening on the whole surface.

[Claim 10] The hot blast which a blower has inhalation opening in the field by the side of a substrate, and passes along said 1st path is reflow soldering equipment according to claim 9 characterized by being constituted so that it may be inhaled by inhalation opening of a blower from opening currently formed in the part intermedia of said ventilation flue.

[Claim 11] The hot blast which a blower has inhalation opening in the field by the side of a substrate, and the hot blast passing through said 1st path is inhaled by inhalation opening of a blower from opening currently formed in the part intermedia of said ventilation flue, and passes along said 2nd path is reflow soldering equipment according to claim 9 characterized by being constituted so that it may be inhaled by inhalation opening of a blower from opening currently formed in the end face of said ventilation flue.

[Claim 12] Reflow soldering equipment according to claim 1 to 11 characterized by the blower consisting of a turbo fan or a sirocco fan.

[Claim 13] Reflow soldering equipment according to claim 1 to 12 characterized by supplying nitrogen gas in said

heating furnace.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the reflow soldering equipment which solders using the hot blast through which it circulates while conveying the substrate with which the inside of a heating furnace was carried in electronic parts by conveyer.

[0002]

[Description of the Prior Art] Reflow soldering equipment is equipment which heats in a heating furnace, conveying the substrate carrying electronic parts by the conveyor chain, is made to carry out melting of the cream solder, and solders electronic parts on a substrate.

[0003] There are some which a blower and a heater are arranged and carry out reflow soldering of the electronic parts by hot blast in this reflow soldering equipment. Generally the reflow soldering equipment of this method has two or more preheating rooms and one reflow soldering room in order along the conveyance direction of a conveyor chain, and the blower and the heater are formed in each preheating room and a reflow soldering room, respectively. The blower and the heater are arranged up and down on both sides of the conveyor chain, and are sprayed on the printed circuit board in which it was led to a means of the \*\* style by which the hot blast heated through the heater by the blower is formed in each interior of a room, and the electronic parts on a conveyor chain were carried. The means of the \*\* style equips the printed circuit board on a conveyor chain with the nozzle plate which sets spacing and arrange it horizontally, and hot blast is sprayed on the printed circuit board in which electronic parts were carried from two or more nozzle holes currently formed in this nozzle plate.

[0004]

[Problem(s) to be Solved by the Invention] In the above, since the hot blast sprayed near the edge of a printed circuit board from the nozzle hole of a nozzle plate flows into the space section of the side after heating near the edge of a printed circuit board, the hot blast always heated by predetermined temperature is sprayed near the edge of a printed circuit board. However, after the hot blast sprayed near the center section of the printed circuit board from the nozzle hole of a nozzle plate heats near the center section of the printed circuit board, it cannot flow into the space section of the side easily, and tends to pile up near the. Consequently, a difference is produced to heating temperature near an edge and near a center section a printed circuit board, and it has the problem from which heating temperature distribution become an ununiformity.

[0005] This invention aims at offering the reflow soldering equipment which made flow of hot blast smooth so that it might be made in view of the above-mentioned situation and the heating temperature distribution of the substrate carrying electronic parts might become homogeneity.

[0006]

[Means for Solving the Problem] This invention takes the following solution means, in order to solve the above-mentioned technical problem. Namely, this invention is set to the reflow soldering equipment which solders electronic parts to a substrate using the hot blast through which it circulates, conveying the substrate with which the inside of a heating furnace was carried in electronic parts by conveyer. On the field which counters a substrate, in the conveyance direction of a conveyor, the ventilation flue which has opening into which hot blast flows in the side which attends a substrate sets spacing, and are prepared. [ two or more ] Hot blast which flowed into these ventilation flues is characterized by having the 1st path which flows to a blower from opening currently formed in the pars intermedia of a ventilation flue apart from said opening.

[0007] According to the above, the hot blast sprayed on the substrate carrying electronic parts flows in a ventilation flue from opening which attends a substrate side, and flows from opening currently formed in the pars intermedia of a ventilation flue smoothly to a blower.

[0008] As for this invention, it is desirable to have the 2nd path other than the 1st path of the above. That is, it is desirable to have the 2nd path where the hot blast which flowed into said ventilation flue flows from opening currently formed in the end face of a ventilation flue to a blower.

[0009] According to the above, since the hot blast sprayed on the substrate carrying electronic parts flows to a blower through the 1st path of the above and also flows from opening currently formed in the end face of a ventilation flue to a blower after flowing in a ventilation flue from opening which attends a substrate side, it can circulate through hot blast more smoothly.

[0010] Said ventilation flue is formed as a long and slender ventilation flue which crosses in the conveyance direction of a conveyer. And the ventilation flue of the hot blast which blows hot blast against a substrate is good to be prepared between each ventilation flue where said hot blast flows more preferably between the ventilation flues where said hot blast flows. In that case, the ventilation flue of the hot blast which blows hot blast against a substrate is formed as a long and slender ventilation flue which crosses in the conveyance direction of a conveyer.

[0011] As for the hot blast which a blower has inhalation opening to both sides which counter, and the hot blast passing through the 1st path is inhaled by one inhalation opening of a blower, and passes along the 2nd path when it has the 1st and 2nd paths, it is desirable to constitute so that it may be inhaled by inhalation opening of another side of a blower on the configuration which circulates hot blast smoothly.

[0012] In that case, for example, the hot blast which a blower has inhalation opening in the field and the field of an opposite hand by the side of a substrate, and passes along the 1st path The hot blast which is inhaled by inhalation opening prepared in the field by the side of the substrate of a blower from opening currently formed in the pars intermedia of said ventilation flue, and passes along the 2nd path It is desirable to constitute so that it may be inhaled from opening currently formed in the end face of said ventilation flue by inhalation opening prepared in the substrate of a blower and the field of an opposite hand.

[0013] It constitutes as one blower, and also the blower which has inhalation opening to both sides which counter may be constituted combining two blowers.

[0014] In addition, although it is desirable to have inhalation opening in the second page as mentioned above as for a blower, it may have inhalation opening on the whole surface.

[0015] In that case, as for the hot blast which a blower has inhalation opening in the field by the side of a substrate when it has the 1st path, and passes along the 1st path, it is desirable to constitute so that it may be inhaled by inhalation opening of a blower from opening currently formed in the pars intermedia of said ventilation flue.

[0016] Moreover, as for the hot blast which a blower has inhalation opening in the field by the side of a substrate when it has the 1st and 2nd paths, the hot blast passing through the 1st path is inhaled by inhalation opening of a blower from opening currently formed in the pars intermedia of said ventilation flue, and passes along the 2nd path, it is desirable to constitute so that it may be inhaled by inhalation opening of a blower from opening currently formed in the end face of said ventilation flue.

[0017] A blower consists of a turbo fan or a sirocco fan. Since in the case of the blower which has inhalation opening to both sides thickness of a blower can be made thin as it is a turbo fan, it is desirable.

[0018] Although an air ambient atmosphere is sufficient as the inside of a heating furnace, it is desirable that nitrogen gas is supplied in respect of antioxidizing.

[0019]  
[Embodiment of the Invention] Hereafter, 1 operation gestalt of this invention is explained based on drawing 1 - drawing 7.

[0020] Reflow soldering equipment has the long and slender heating furnace 1. In the heating furnace 1, in order to prevent oxidation of electronic parts and solder, nitrogen gas is supplied. The printed circuit board 2 in which electronic parts were carried has the inside of a heating furnace 1 conveyed by the conveyor chain 3.

[0021] It is divided into eight \*\* with the bridgewall 4, and the heating furnace 1 is equipped with seven preheating rooms 5 and one reflow soldering room 6 in order along the conveyance direction. The preheating room 5 is \*\* for heating gradually the printed circuit board 2 in which electronic parts were carried. The printed circuit board 2 in which electronic parts were carried is heated by about 150 degrees C at this preheating room 5. The reflow soldering room 6 is \*\* which fuses cream solder and solders electronic parts. The printed circuit board 2 in which electronic parts were carried is heated by about 230 degrees C at this reflow soldering room 6. Moreover, the cooling section 7 is a part for cooling the printed circuit board 2 in which the electronic parts in the elevated-temperature condition after soldering were carried, and is adjoined and prepared in the heating furnace 1.

[0022] It is arranged at a horizontal to the cooling section 7 which an outward trip penetrates the abbreviation center section of the vertical direction in a heating furnace 1 from the entrance side of a heating furnace 1, and a conveyor chain 3 adjoins the outlet of a heating furnace 1, and is arranged, and the return trip is arranged down the heating furnace 1. Opening by which 1a is formed in the inlet-port wall and outlet wall of a heating furnace 1, and 4a are openings currently formed in the bridgewall 4. After being laid in a conveyor chain 3 by the entrance side of a heating furnace 1 and moving by the conveyor chain 3 in the inside of a heating furnace 1, the printed circuit board 2 in which electronic parts were carried passes along the cooling section 7, and are collected after that.

[0023] On both sides of the conveyor chain 3, the hot blast circulation system of the same structure is formed in each \*\* 5 and 6 of a heating furnace 1 up and down. Hereafter, the equipment by the side of the upper part is explained.

[0024] The blower 8 is formed in the upper bed section of each \*\* 5 and 6 of a heating furnace 1, respectively, and it has connected with each motor 9 installed in the top face outside a heating furnace 1. On both sides of a griddle 10, a wing is arranged at the upper and lower sides, it has the inhalation opening 11 on the top face, and it has a delivery 12 on a periphery, it has the inhalation opening 13 on the underside, and the blower 8 has the delivery 14 on the periphery. Although a blower 8 consists of a sirocco fan and a turbo fan, with this operation gestalt, it consists of turbo fans and is contained in the 1st casing 15.

[0025] The 1st casing 15 consists of blower stowage 15a and air induction part 15b. Blower stowage 15a contains a blower 8, and it has the inhalation openings 16 and 17 in the vertical side which counters the inhalation openings 11 and 13 of a blower 8, respectively, and air induction part 15b is jugged out of right-and-left opening of blower stowage 15a over right and left, and has the end connections 18 and 19 the point curved caudad and turned [ end connections ] to the lower part. Although the 1st casing 15 is a rectangle in plane view and there is almost no clearance between bridgewalls 4, the space section 20 is between the left and right laterals of each \*\* 5 and 6, and since spacing is opened in the bottom a little and it is arranged rather than the top face, the space section 21 is formed between the top faces of each \*\* 5 and 6. And the heater 23 is arranged at the space section 20 of the side of the 1st casing 15, and the space section 22 under it. Although especially the class of heater 23 is not asked, the sheath heater is used with this operation gestalt.

[0026] The 2nd casing 24 arranges under the 1st casing 15. The 2nd casing 24 contains a ventilation flue formation member, and consists of ventilation flue formation member stowage 24a and air induction part 24b with this operation gestalt. The underside has opened ventilation flue formation member stowage 24a in the rectangular case by plane view. Air induction part 24b is prolonged in the upper part from top-face opening currently formed in the left right end section of ventilation flue formation member stowage 24a, it has the end connections 25 and 26 which turned to the upper part, and the end connections 18 and 19 of the 1st casing 15 are connected to those end connections 25 and 26. Although the 2nd casing 24 does not almost have a clearance between bridgewalls 4, the space section 22 is between the side faces of each \*\* 5 and right and left of six.

[0027] The ventilation flue formation member 28 is contained in the 2nd casing 24. Wall 28a by which the ventilation-flue formation member 28 is making the configuration crooked in the wave in the plate, sets spacing in the conveyance direction of a conveyor chain 3, and two or more arrays are carried out at parallel, It is formed by roof wall 28b of a cross-section abbreviation reverse V character configuration which connects the upper bed of adjoining wall 28a, and nozzle formation wall 28c of the cross-section abbreviation configuration for V characters which connects the soffit of adjoining wall 28a, and roof wall 28b and nozzle formation wall 28c are formed in the conveyance direction of a conveyor chain 3 by turns. As the upper bed arranges the ventilation flue formation member 28 in an upper location for a while rather than the level top face 29 of the pars intermedia of the 2nd casing 24, receipt immobilization is carried out into the 2nd casing 24. Therefore, notching of the pars intermedia of the ventilation flue formation member 28 is carried out so that it may apply to the upper bed section of roof wall 28b to wall 28a and may have consistency in the level top face 29 of the pars intermedia of the 2nd casing 24, and the inclined plane 30 of air induction part 24b of the both sides, and it forms the long and slender opening 31. And also corresponding to the level top face 29 and level inclined plane 30 of the 2nd casing 24 which two or more long and slender openings 31 have overlooked, two or more formation of the long and slender isomorphism-like opening 32 is carried out.

[0028] In the base of nozzle formation wall 28c, spacing is set at a longitudinal direction, and two or more nozzle holes 33 are formed. The long and slender space section which is divided with wall 28a of the ventilation flue formation member 28, and has the nozzle hole 33 forms the ventilation flue 34 of the hot blast which blows hot blast against the printed circuit board 2 in which electronic parts were carried. Moreover, the long and slender space section which it is divided with wall 28a of the ventilation flue formation member 28, and roof wall 28b faces forms the ventilation flue 35 where hot blast flows. It extends to the lateral portion of right and left of the 2nd casing 24, the margo inferior of the side face of the 2nd casing 24 is formed, the edge of the right and left of a ventilation flue 34 which spray hot blast on a printed circuit board 2 is blockaded, and the ventilation flue formation member 28 is carrying out opening of the edge of right and left of the ventilation flue 35 where hot blast flows.

[0029] Although the above explained the hot blast circulation system of a conveyor-chain 3 upside, the hot blast circulation system of the conveyor-chain 3 bottom is constituted similarly.

[0030] Next, an operation of this invention is explained.

[0031] The printed circuit board 2 in which electronic parts were carried is put on a conveyor chain 3 by the entrance side of a heating furnace 1, and has the inside of a heating furnace 1 conveyed by the conveyor chain 3. At the preheating room 5 and the reflow soldering room 6 of a heating furnace 1, the blower 8 in each \*\* 5 and 6 rotates by the motor 9.

[0032] Hereafter, it explains based on an upper hot blast circulation system.

[0033] Hot blast is breathed out from the end connections 18 and 19 on either side through air induction part 15b of the 1st casing 15 to the 2nd casing 24 by the blower 8. The hot blast breathed out from air induction part 15b of the 1st casing 15 enters in the 2nd casing 24 from air induction part 24b of the 2nd casing 24, and is sprayed on the



printed circuit board 2 in which the electronic parts on a conveyor chain 3 were carried from the nozzle hole 33 of a ventilation flue 34.

[0034] The hot blast sprayed on the printed circuit board 2 in which electronic parts were carried flows into a ventilation flue 35 from opening 35a of the side which attends the printed circuit board 2 of a ventilation flue 35, after heating the printed circuit board 2 in which electronic parts were carried. And the hot blast which flowed into the ventilation flue 35 passes along the 2nd path, and is inhaled by the inhalation opening 11 of the top face of a blower 8 while it passes along the 1st path and is inhaled by the inhalation opening 13 of the underside of a blower 8. That is, with this operation gestalt, the hot blast which flowed into the ventilation flue 35 passes along the opening 31 prepared in the pars intermedia in the longitudinal direction of a ventilation flue 35, and the opening 32 of the 2nd casing 24, flows into the space section 27 of the lower part of a blower 8, and is inhaled by the inhalation opening 13 of the underside of a blower 8. On the other hand, flowing into the space section 22 of the side out of opening 35b currently formed in the ends side of a ventilation flue 35, and being heated at a heater 23, the hot blast which flowed into the ventilation flue 35 goes into the upper space section 21 of the 1st casing 15 through the upper space section 20, and is inhaled by the inhalation opening 11 of the top face of a blower 8.

[0035] And hot blast is breathed out into the 2nd casing 24 from air induction part 15b of the 1st casing 15 by the blower 8, the printed circuit board 2 in which electronic parts were carried from the nozzle hole 33 is sprayed, and the printed circuit board 2 in which electronic parts were carried is heated.

[0036] Although the above was explained based on the upper hot blast circulation system, a lower hot blast circulation system acts similarly.

[0037] Since it circulates through the hot blast which heats the printed circuit board 2 in which electronic parts were carried as above smoothly, without piling up, the heating temperature distribution of the printed circuit board 2 in which electronic parts were carried become homogeneity.

[0038] The printed circuit board 2 in which electronic parts were carried as mentioned above is heated gradually at the preheating room 5, melting of the cream solder is carried out and electronic parts are soldered good on a printed circuit board 2 at the reflow soldering room 6. Then, the printed circuit board 2 in which these electronic parts were carried comes out from a heating furnace 1, and while passing along the cooling section 7, temperature is lowered gradually and they are collected.

[0039] Drawing 8 shows another operation gestalt of this invention. The configuration of a blower and a heater is different from the above-mentioned operation gestalt, and, as for this operation gestalt, other configurations are the same as the above-mentioned operation gestalt.

[0040] The blower 8 in this operation gestalt consists of sirocco fans which have the inhalation opening 13 only on the underside and have delivery 14a on the periphery. Moreover, the heater 23 is arranged at the space section 27 of the lower part of a blower 8.

[0041] Therefore, in this operation gestalt, if the operation is explained based on an upper hot blast circulation system, hot blast will be inhaled from the inhalation opening 13 at the bottom, they will enter in the 2nd casing 24 from the 1st casing 15 like the above-mentioned operation gestalt, and a blower 8 will be sprayed on the printed circuit board 2 in which the electronic parts on a conveyor chain 3 were carried from the nozzle hole 33 of a ventilation flue 34.

[0042] The hot blast sprayed on the printed circuit board 2 in which electronic parts were carried flows into a ventilation flue 35 from opening 35a of the side which attends the printed circuit board 2 of a ventilation flue 35, after heating the printed circuit board 2 in which electronic parts were carried. And the hot blast which flowed into the ventilation flue 35 passes along the 1st path, and is inhaled by the inhalation opening 13 of the underside of a blower 8. That is, the hot blast which flowed into the ventilation flue 35 passes along the opening 31 prepared in the pars intermedia in the longitudinal direction of a ventilation flue 35, and the opening 32 of the 2nd casing 24, flows into the space section 27 of the lower part of a blower 8, and is inhaled by the inhalation opening 13 of the underside of a blower 8.

[0043] And hot blast is breathed out into the 2nd casing 24 from air induction part 15b of the 1st casing 15 by the blower 8, the printed circuit board 2 in which electronic parts were carried from the nozzle hole 33 is sprayed, and the printed circuit board 2 in which electronic parts were carried is heated.

[0044] Although the above was explained based on the upper hot blast circulation system, a lower hot blast circulation system acts similarly.

[0045] Also in this operation gestalt, since it circulates through the hot blast which heats the printed circuit board 2 in which electronic parts were carried as above-mentioned smoothly, without piling up, the heating temperature distribution of the printed circuit board 2 in which electronic parts were carried become homogeneity.

[0046] Drawing 9 shows still more nearly another operation gestalt of this invention. This operation gestalt is the point that the hot blast after substrate heating is inhaled by the blower 8 through the 2nd path besides the 1st path, and is different from the operation gestalt explained by drawing 8. Other configurations are the same as the operation gestalt explained by drawing 8.

[0047] It constitutes from this operation gestalt so that the space sections 36 and 37 may exist between the 1st casing



15 and the 2nd casing 24, and the left and right laterals of each \*\* 5 and 6.

[0048] Therefore, in this operation gestalt, if the operation is explained based on an upper hot blast circulation system, hot blast will be inhaled from the inhalation opening 13 at the bottom, they will enter in the 2nd casing 24 from the 1st casing 15 like the above-mentioned operation gestalt, and a blower 8 will be sprayed on the printed circuit board 2 in which the electronic parts on a conveyor chain 3 were carried from the nozzle hole 33 of a ventilation flue 34.

[0049] The hot blast sprayed on the printed circuit board 2 in which electronic parts were carried flows into a ventilation flue 35 from opening 35a of the side which attends the printed circuit board 2 of a ventilation flue 35, after heating the printed circuit board 2 in which electronic parts were carried. And as explained above, the hot blast which flowed into the ventilation flue 35 passes along the 1st path, and is inhaled by the inhalation opening 13 of the underside of a blower 8. And in this operation gestalt, further, the hot blast which flowed into the ventilation flue 35 passes along the 2nd path, and is inhaled by the inhalation opening 13 of the underside of a blower 8. That is, the hot blast which flowed into the ventilation flue 35 flows into the space section 22 of the side out of opening 35b currently formed in the ends side of a ventilation flue 35, goes into the space section 27 of the lower part of a blower 8 from the space sections 36 and 37 currently formed between the 1st casing 15 and the 2nd casing 24, and the left and right laterals of each \*\* 5 and 6, and is inhaled by the inhalation opening 13 of the underside of a blower 8.

[0050] And hot blast is breathed out into the 2nd casing 24 from air induction part 15b of the 1st casing 15 by the blower 8, the printed circuit board 2 in which electronic parts were carried from the nozzle hole 33 is sprayed, and the printed circuit board 2 in which electronic parts were carried is heated.

[0051] Although the above was explained based on the upper hot blast circulation system, a lower hot blast circulation system acts similarly.

[0052] Also in this operation gestalt, since it circulates through the hot blast which heats the printed circuit board 2 in which electronic parts were carried as above-mentioned smoothly, without piling up, the heating temperature distribution of the printed circuit board 2 in which electronic parts were carried become homogeneity.

[0053] In addition, although the above-mentioned operation gestalt showed the reflow soldering equipment which solders by the hot blast through which it circulates, it cannot be overemphasized that this invention is applicable also to the reflow soldering equipment which uses a far-infrared heater together in addition to using hot blast.

[0054]

[Effect of the Invention] Since the hot blast which heats the substrate carrying electronic parts circulates smoothly according to the reflow soldering equipment of this invention, without piling up as explained above, the heating temperature distribution of the substrate carrying electronic parts become homogeneity, and enable good soldering.

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**TECHNICAL FIELD**

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[Field of the Invention] This invention relates to the reflow soldering equipment which solders using the hot blast through which it circulates while conveying the substrate with which the inside of a heating furnace was carried in electronic parts by conveyer.

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**PRIOR ART**

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[Description of the Prior Art] Reflow soldering equipment is equipment which heats in a heating furnace, conveying the substrate carrying electronic parts by the conveyor chain, is made to carry out melting of the cream solder, and solders electronic parts on a substrate.

[0003] There are some which a blower and a heater are arranged and carry out reflow soldering of the electronic parts by hot blast in this reflow soldering equipment. Generally the reflow soldering equipment of this method has two or more preheating rooms and one reflow soldering room in order along the conveyance direction of a conveyor chain, and the blower and the heater are formed in each preheating room and a reflow soldering room, respectively. The blower and the heater are arranged up and down on both sides of the conveyor chain, and are sprayed on the printed circuit board in which it was led to a means of the \*\* style by which the hot blast heated through the heater by the blower is formed in each interior of a room, and the electronic parts on a conveyor chain were carried. The means of the \*\* style equips the printed circuit board on a conveyor chain with the nozzle plate which sets spacing and arranges it horizontally, and hot blast is sprayed on the printed circuit board in which electronic parts were carried from two or more nozzle holes currently formed in this nozzle plate.

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EFFECT OF THE INVENTION

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[Effect of the Invention] Since the hot blast which heats the substrate carrying electronic parts circulates smoothly according to the reflow soldering equipment of this invention, without piling up as explained above, the heating temperature distribution of the substrate carrying electronic parts become homogeneity, and enable good soldering.

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**TECHNICAL PROBLEM**

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[Problem(s) to be Solved by the Invention] In the above, since the hot blast sprayed near the edge of a printed circuit board from the nozzle hole of a nozzle plate flows into the space section of the side after heating near the edge of a printed circuit board, the hot blast always heated by predetermined temperature is sprayed near the edge of a printed circuit board. However, after the hot blast sprayed near the center section of the printed circuit board from the nozzle hole of a nozzle plate heats near the center section of the printed circuit board, it cannot flow into the space section of the side easily, and tends to pile up near the. Consequently, a difference is produced to heating temperature near an edge and near a center section a printed circuit board, and it has the problem from which heating temperature distribution become an ununiformity.

[0005] This invention aims at offering the reflow soldering equipment which made flow of hot blast smooth so that it might be made in view of the above-mentioned situation and the heating temperature distribution of the substrate carrying electronic parts might become homogeneity.

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[Translation done.]

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MEANS

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[Means for Solving the Problem] This invention takes the following solution means, in order to solve the above-mentioned technical problem. Namely, this invention is set to the reflow soldering equipment which solders electronic parts to a substrate using the hot blast through which it circulates, conveying the substrate with which the inside of a heating furnace was carried in electronic parts by conveyer. On the field which counters a substrate, in the conveyance direction of a conveyer, the ventilation flue which has opening into which hot blast flows in the side which attends a substrate sets spacing, and are prepared. [ two or more ] Hot blast which flowed into these ventilation flues is characterized by having the 1st path which flows to a blower from opening currently formed in the pars intermedia of a ventilation flue apart from said opening.

[0007] According to the above, the hot blast sprayed on the substrate carrying electronic parts flows in a ventilation flue from opening which attends a substrate side, and flows from opening currently formed in the pars intermedia of a ventilation flue smoothly to a blower.

[0008] As for this invention, it is desirable to have the 2nd path other than the 1st path of the above. That is, it is desirable to have the 2nd path where the hot blast which flowed into said ventilation flue flows from opening currently formed in the end face of a ventilation flue to a blower.

[0009] According to the above, since the hot blast sprayed on the substrate carrying electronic parts flows to a blower through the 1st path of the above and also flows from opening currently formed in the end face of a ventilation flue to a blower after flowing in a ventilation flue from opening which attends a substrate side, it can circulate through hot blast more smoothly.

[0010] Said ventilation flue is formed as a long and slender ventilation flue which crosses in the conveyance direction of a conveyer. And the ventilation flue of the hot blast which blows hot blast against a substrate is good to be prepared between each ventilation flue where said hot blast flows more preferably between the ventilation flues where said hot blast flows. In that case, the ventilation flue of the hot blast which blows hot blast against a substrate is formed as a long and slender ventilation flue which crosses in the conveyance direction of a conveyer.

[0011] As for the hot blast which a blower has inhalation opening to both sides which counter, and the hot blast passing through the 1st path is inhaled by one inhalation opening of a blower, and passes along the 2nd path when it has the 1st and 2nd paths, it is desirable to constitute so that it may be inhaled by inhalation opening of another side of a blower on the configuration which circulates hot blast smoothly.

[0012] In that case, for example, the hot blast which a blower has inhalation opening in the field and the field of an opposite hand by the side of a substrate, and passes along the 1st path The hot blast which is inhaled by inhalation opening prepared in the field by the side of the substrate of a blower from opening currently formed in the pars intermedia of said ventilation flue, and passes along the 2nd path It is desirable to constitute so that it may be inhaled from opening currently formed in the end face of said ventilation flue by inhalation opening prepared in the substrate of a blower and the field of an opposite hand.

[0013] It constitutes as one blower, and also the blower which has inhalation opening to both sides which counter may be constituted combining two blowers.

[0014] In addition, although it is desirable to have inhalation opening in the second page as mentioned above as for a blower, it may have inhalation opening on the whole surface.

[0015] In that case, as for the hot blast which a blower has inhalation opening in the field by the side of a substrate when it has the 1st path, and passes along the 1st path, it is desirable to constitute so that it may be inhaled by inhalation opening of a blower from opening currently formed in the pars intermedia of said ventilation flue.

[0016] Moreover, as for the hot blast which a blower has inhalation opening in the field by the side of a substrate when it has the 1st and 2nd paths, the hot blast passing through the 1st path is inhaled by inhalation opening of a blower from opening currently formed in the pars intermedia of said ventilation flue, and passes along the 2nd path, it is desirable to constitute so that it may be inhaled by inhalation opening of a blower from opening currently formed in the end face of said ventilation flue.

[0017] A blower consists of a turbo fan or a sirocco fan. Since in the case of the blower which has inhalation opening

to both sides thickness of a blower can be made thin as it is a turbo fan, it is desirable.

[0018] Although an air ambient atmosphere is sufficient as the inside of a heating furnace, it is desirable that nitrogen gas is supplied in respect of antioxidizing.

[0019]

[Embodiment of the Invention] Hereafter, 1 operation gestalt of this invention is explained based on drawing 1 - drawing 7.

[0020] Reflow soldering equipment has the long and slender heating furnace 1. In the heating furnace 1, in order to prevent oxidation of electronic parts and solder, nitrogen gas is supplied. The printed circuit board 2 in which electronic parts were carried has the inside of a heating furnace 1 conveyed by the conveyor chain 3.

[0021] It is divided into eight \*\* with the bridgewall 4, and the heating furnace 1 is equipped with seven preheating rooms 5 and one reflow soldering room 6 in order along the conveyance direction. The preheating room 5 is \*\* for heating gradually the printed circuit board 2 in which electronic parts were carried. The printed circuit board 2 in which electronic parts were carried is heated by about 150 degrees C at this preheating room 5. The reflow soldering room 6 is \*\* which fuses cream solder and solders electronic parts. The printed circuit board 2 in which electronic parts were carried is heated by about 230 degrees C at this reflow soldering room 6. Moreover, the cooling section 7 is a part for cooling the printed circuit board 2 in which the electronic parts in the elevated-temperature condition after soldering were carried, and is adjoined and prepared in the heating furnace 1.

[0022] It is arranged at a horizontal to the cooling section 7 which an outward trip penetrates the abbreviation center section of the vertical direction in a heating furnace 1 from the entrance side of a heating furnace 1, and a conveyor chain 3 adjoins the outlet of a heating furnace 1, and is arranged, and the return trip is arranged down the heating furnace 1. Opening by which 1a is formed in the inlet-port wall and outlet wall of a heating furnace 1, and 4a are openings currently formed in the bridgewall 4. After being laid in a conveyor chain 3 by the entrance side of a heating furnace 1 and moving by the conveyor chain 3 in the inside of a heating furnace 1, the printed circuit board 2 in which electronic parts were carried passes along the cooling section 7, and are collected after that.

[0023] On both sides of the conveyor chain 3, the hot blast circulation system of the same structure is formed in each \*\* 5 and 6 of a heating furnace 1 up and down. Hereafter, the equipment by the side of the upper part is explained.

[0024] The blower 8 is formed in the upper bed section of each \*\* 5 and 6 of a heating furnace 1, respectively, and it has connected with each motor 9 installed in the top face outside a heating furnace 1. On both sides of a griddle 10, a wing is arranged at the upper and lower sides, it has the inhalation opening 11 on the top face, and it has a delivery 12 on a periphery, it has the inhalation opening 13 on the underside, and the blower 8 has the delivery 14 on the periphery. Although a blower 8 consists of a sirocco fan and a turbo fan, with this operation gestalt, it consists of turbo fans and is contained in the 1st casing 15.

[0025] The 1st casing 15 consists of blower stowage 15a and air induction part 15b. Blower stowage 15a contains a blower 8, and it has the inhalation openings 16 and 17 in the vertical side which counters the inhalation openings 11 and 13 of a blower 8, respectively, and air induction part 15b is jutted out of right-and-left opening of blower stowage 15a over right and left, and has the end connections 18 and 19 the point curved caudad and turned [ end connections ] to the lower part. Although the 1st casing 15 is a rectangle in plane view and there is almost no clearance between bridgewalls 4, the space section 20 is between the left and right laterals of each \*\* 5 and 6, and since spacing is opened in the bottom a little and it is arranged rather than the top face, the space section 21 is formed between the top faces of each \*\* 5 and 6. And the heater 23 is arranged at the space section 20 of the side of the 1st casing 15, and the space section 22 under it. Although especially the class of heater 23 is not asked, the sheath heater is used with this operation gestalt.

[0026] The 2nd casing 24 arranges under the 1st casing 15. The 2nd casing 24 contains a ventilation flue formation member, and consists of ventilation flue formation member stowage 24a and air induction part 24b with this operation gestalt. The underside has opened ventilation flue formation member stowage 24a in the rectangular case by plane view. Air induction part 24b is prolonged in the upper part from top-face opening currently formed in the left right end section of ventilation flue formation member stowage 24a, it has the end connections 25 and 26 which turned to the upper part, and the end connections 18 and 19 of the 1st casing 15 are connected to those end connections 25 and 26. Although the 2nd casing 24 does not almost have a clearance between bridgewalls 4, the space section 22 is between the side faces of each \*\* 5 and right and left of six.

[0027] The ventilation flue formation member 28 is contained in the 2nd casing 24. Wall 28a by which the ventilation-flue formation member 28 is making the configuration crooked in the wave in the plate, sets spacing in the conveyance direction of a conveyor chain 3, and two or more arrays are carried out at parallel, It is formed by roof wall 28b of a cross-section abbreviation reverse V character configuration which connects the upper bed of adjoining wall 28a, and nozzle formation wall 28c of the cross-section abbreviation configuration for V characters which connects the soffit of adjoining wall 28a, and roof wall 28b and nozzle formation wall 28c are formed in the conveyance direction of a conveyor chain 3 by turns. As the upper bed arranges the ventilation flue formation member 28 in an upper location for a while rather than the level top face 29 of the pars intermedia of the 2nd casing 24, receipt



immobilization is carried out into the 2nd casing 24. Therefore, notching of the pars intermedia of the ventilation flue formation member 28 is carried out so that it may apply to the upper bed section of roof wall 28b to wall 28a and may have consistency in the level top face 29 of the pars intermedia of the 2nd casing 24, and the inclined plane 30 of air induction part 24b of the both sides, and it forms the long and slender opening 31. And also corresponding to the level top face 29 and level inclined plane 30 of the 2nd casing 24 which two or more long and slender openings 31 have overlooked, two or more formation of the long and slender isomorphism-like opening 32 is carried out.

[0028] In the base of nozzle formation wall 28c, spacing is set at a longitudinal direction, and two or more nozzle holes 33 are formed. The long and slender space section which is divided with wall 28a of the ventilation flue formation member 28, and has the nozzle hole 33 forms the ventilation flue 34 of the hot blast which blows hot blast against the printed circuit board 2 in which electronic parts were carried. Moreover, the long and slender space section which it is divided with wall 28a of the ventilation flue formation member 28, and roof wall 28b faces forms the ventilation flue 35 where hot blast flows. It extends to the lateral portion of right and left of the 2nd casing 24, the margo inferior of the side face of the 2nd casing 24 is formed, the edge of the right and left of a ventilation flue 34 which spray hot blast on a printed circuit board 2 is blockaded, and the ventilation flue formation member 28 is carrying out opening of the edge of right and left of the ventilation flue 35 where hot blast flows.

[0029] Although the above explained the hot blast circulation system of a conveyor-chain 3 upside, the hot blast circulation system of the conveyor-chain 3 bottom is constituted similarly.

[0030] Next, an operation of this invention is explained.

[0031] The printed circuit board 2 in which electronic parts were carried is put on a conveyor chain 3 by the entrance side of a heating furnace 1, and has the inside of a heating furnace 1 conveyed by the conveyor chain 3. At the preheating room 5 and the reflow soldering room 6 of a heating furnace 1, the blower 8 in each \*\* 5 and 6 rotates by the motor 9.

[0032] Hereafter, it explains based on an upper hot blast circulation system.

[0033] Hot blast is breathed out from the end connections 18 and 19 on either side through air induction part 15b of the 1st casing 15 to the 2nd casing 24 by the blower 8. The hot blast breathed out from air induction part 15b of the 1st casing 15 enters in the 2nd casing 24 from air induction part 24b of the 2nd casing 24, and is sprayed on the printed circuit board 2 in which the electronic parts on a conveyor chain 3 were carried from the nozzle hole 33 of a ventilation flue 34.

[0034] The hot blast sprayed on the printed circuit board 2 in which electronic parts were carried flows into a ventilation flue 35 from opening 35a of the side which attends the printed circuit board 2 of a ventilation flue 35, after heating the printed circuit board 2 in which electronic parts were carried. And the hot blast which flowed into the ventilation flue 35 passes along the 2nd path, and is inhaled by the inhalation opening 11 of the top face of a blower 8 while it passes along the 1st path and is inhaled by the inhalation opening 13 of the underside of a blower 8. That is, with this operation gestalt, the hot blast which flowed into the ventilation flue 35 passes along the opening 31 prepared in the pars intermedia in the longitudinal direction of a ventilation flue 35, and the opening 32 of the 2nd casing 24, flows into the space section 27 of the lower part of a blower 8, and is inhaled by the inhalation opening 13 of the underside of a blower 8. On the other hand, flowing into the space section 22 of the side out of opening 35b currently formed in the ends side of a ventilation flue 35, and being heated at a heater 23, the hot blast which flowed into the ventilation flue 35 goes into the upper space section 21 of the 1st casing 15 through the upper space section 20, and is inhaled by the inhalation opening 11 of the top face of a blower 8.

[0035] And hot blast is breathed out into the 2nd casing 24 from air induction part 15b of the 1st casing 15 by the blower 8, the printed circuit board 2 in which electronic parts were carried from the nozzle hole 33 is sprayed, and the printed circuit board 2 in which electronic parts were carried is heated.

[0036] Although the above was explained based on the upper hot blast circulation system, a lower hot blast circulation system acts similarly.

[0037] Since it circulates through the hot blast which heats the printed circuit board 2 in which electronic parts were carried as above smoothly, without piling up, the heating temperature distribution of the printed circuit board 2 in which electronic parts were carried become homogeneity.

[0038] The printed circuit board 2 in which electronic parts were carried as mentioned above is heated gradually at the preheating room 5, melting of the cream solder is carried out and electronic parts are soldered good on a printed circuit board 2 at the reflow soldering room 6. Then, the printed circuit board 2 in which these electronic parts were carried comes out from a heating furnace 1, and while passing along the cooling section 7, temperature is lowered gradually and they are collected.

[0039] Drawing 8 shows another operation gestalt of this invention. The configuration of a blower and a heater is different from the above-mentioned operation gestalt, and, as for this operation gestalt, other configurations are the same as the above-mentioned operation gestalt.

[0040] The blower 8 in this operation gestalt consists of sirocco fans which have the inhalation opening 13 only on the underside and have delivery 14a on the periphery. Moreover, the heater 23 is arranged at the space section 27 of

the lower part of a blower 8.

[0041] Therefore, in this operation gestalt, if the operation is explained based on an upper hot blast circulation system, hot blast will be inhaled from the inhalation opening 13 at the bottom, they will enter in the 2nd casing 24 from the 1st casing 15 like the above-mentioned operation gestalt, and a blower 8 will be sprayed on the printed circuit board 2 in which the electronic parts on a conveyor chain 3 were carried from the nozzle hole 33 of a ventilation flue 34.

[0042] The hot blast sprayed on the printed circuit board 2 in which electronic parts were carried flows into a ventilation flue 35 from opening 35a of the side which attends the printed circuit board 2 of a ventilation flue 35, after heating the printed circuit board 2 in which electronic parts were carried. And the hot blast which flowed into the ventilation flue 35 passes along the 1st path, and is inhaled by the inhalation opening 13 of the underside of a blower 8. That is, the hot blast which flowed into the ventilation flue 35 passes along the opening 31 prepared in the pars intermedia in the longitudinal direction of a ventilation flue 35, and the opening 32 of the 2nd casing 24, flows into the space section 27 of the lower part of a blower 8, and is inhaled by the inhalation opening 13 of the underside of a blower 8.

[0043] And hot blast is breathed out into the 2nd casing 24 from air induction part 15b of the 1st casing 15 by the blower 8, the printed circuit board 2 in which electronic parts were carried from the nozzle hole 33 is sprayed, and the printed circuit board 2 in which electronic parts were carried is heated.

[0044] Although the above was explained based on the upper hot blast circulation system, a lower hot blast circulation system acts similarly.

[0045] Also in this operation gestalt, since it circulates through the hot blast which heats the printed circuit board 2 in which electronic parts were carried as above-mentioned smoothly, without piling up, the heating temperature distribution of the printed circuit board 2 in which electronic parts were carried become homogeneity.

[0046] Drawing 9 shows still more nearly another operation gestalt of this invention. This operation gestalt is the point that the hot blast after substrate heating is inhaled by the blower 8 through the 2nd path besides the 1st path, and is different from the operation gestalt explained by drawing 8. Other configurations are the same as the operation gestalt explained by drawing 8.

[0047] It constitutes from this operation gestalt so that the space sections 36 and 37 may exist between the 1st casing 15 and the 2nd casing 24, and the left and right laterals of each \*\* 5 and 6.

[0048] Therefore, in this operation gestalt, if the operation is explained based on an upper hot blast circulation system, hot blast will be inhaled from the inhalation opening 13 at the bottom, they will enter in the 2nd casing 24 from the 1st casing 15 like the above-mentioned operation gestalt, and a blower 8 will be sprayed on the printed circuit board 2 in which the electronic parts on a conveyor chain 3 were carried from the nozzle hole 33 of a ventilation flue 34.

[0049] The hot blast sprayed on the printed circuit board 2 in which electronic parts were carried flows into a ventilation flue 35 from opening 35a of the side which attends the printed circuit board 2 of a ventilation flue 35, after heating the printed circuit board 2 in which electronic parts were carried. And as explained above, the hot blast which flowed into the ventilation flue 35 passes along the 1st path, and is inhaled by the inhalation opening 13 of the underside of a blower 8. And in this operation gestalt, further, the hot blast which flowed into the ventilation flue 35 passes along the 2nd path, and is inhaled by the inhalation opening 13 of the underside of a blower 8. That is, the hot blast which flowed into the ventilation flue 35 flows into the space section 22 of the side out of opening 35b currently formed in the ends side of a ventilation flue 35, goes into the space section 27 of the lower part of a blower 8 from the space sections 36 and 37 currently formed between the 1st casing 15 and the 2nd casing 24, and the left and right laterals of each \*\* 5 and 6, and is inhaled by the inhalation opening 13 of the underside of a blower 8.

[0050] And hot blast is breathed out into the 2nd casing 24 from air induction part 15b of the 1st casing 15 by the blower 8, the printed circuit board 2 in which electronic parts were carried from the nozzle hole 33 is sprayed, and the printed circuit board 2 in which electronic parts were carried is heated.

[0051] Although the above was explained based on the upper hot blast circulation system, a lower hot blast circulation system acts similarly.

[0052] Also in this operation gestalt, since it circulates through the hot blast which heats the printed circuit board 2 in which electronic parts were carried as above-mentioned smoothly, without piling up, the heating temperature distribution of the printed circuit board 2 in which electronic parts were carried become homogeneity.

[0053] In addition, although the above-mentioned operation gestalt showed the reflow soldering equipment which solders by the hot blast through which it circulates, it cannot be overemphasized that this invention is applicable also to the reflow soldering equipment which uses a far-infrared heater together in addition to using hot blast.

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## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing of longitudinal section showing the reflow soldering equipment which is 1 operation gestalt of this invention.

[Drawing 2] It is important section drawing of longitudinal section of drawing 1 cut at the right angle in the conveyance direction.

[Drawing 3] It is important section drawing of longitudinal section of drawing 1 cut along the conveyance direction.

[Drawing 4] It is the perspective view which looked at the 2nd casing part from the nozzle hole and the opposite hand.

[Drawing 5] It is the perspective view which looked at the 2nd casing part from the nozzle hole side.

[Drawing 6] The 2nd casing part is shown, (a) is a top view and (b) is a front view.

[Drawing 7] It is the amplification part drawing showing the end face by the side of the nozzle hole of a ventilation flue formation member.

[Drawing 8] Another operation gestalt of this invention is shown and it is drawing corresponding to drawing 2.

[Drawing 9] Still more nearly another operation gestalt of this invention is shown, and it is drawing corresponding to drawing 3.

[Description of Notations]

1 .. A heating furnace, 1a .. Opening, 2 .. The printed circuit board in which electronic parts were carried, 3 [ .. Preheating room, ] .. A conveyor chain, 4 .. A bridgewall, 4a .. Opening, 5 6 [ .. Motor, ] .. A reflow soldering room, 7 .. The cooling section, 8 .. A blower, 9 10 [ .. Inhalation opening, ] .. A griddle, 11 .. Inhalation opening, 12 .. A delivery, 13 14 14a .. A delivery, 15 .. The 1st casing, 15a .. Blower stowage, 15b .. 16 An air induction part, 17 .. 18 Inhalation opening, 19 .. End connection, 20, 21, 22 .. The space section, 23 .. A heater, 24 .. The 2nd casing, 24a .. A ventilation flue formation member stowage, 24b .. 25 An air induction part, 26 .. End connection, 27 [ .. Roof wall, ] .. The space section, 28 .. A ventilation flue formation member, 28a .. A wall, 28b 28c .. A nozzle formation wall, 29 .. The water Hiragami side of the 2nd casing, 30 .. The inclined plane of the 2nd casing, 31 32 [ .. A ventilation flue, 35a, 35b into which hot blast flows / .. 36 Opening, 37 / .. Space section. ] .. Opening, 33 .. A nozzle hole, 34 .. The ventilation flue, 35 which spray hot blast on a substrate

[Translation done.]

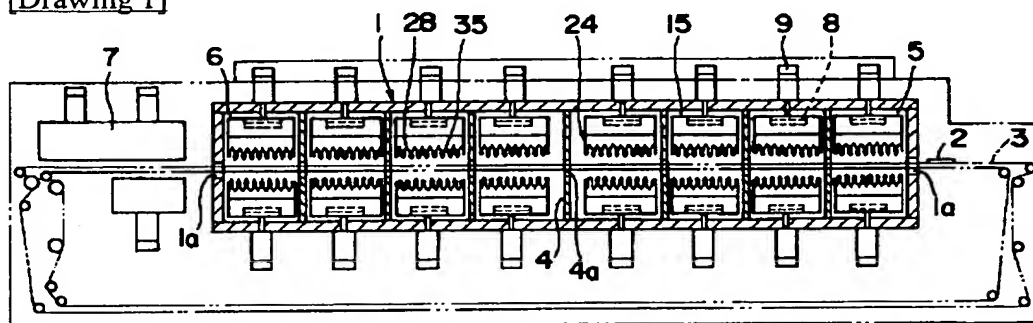
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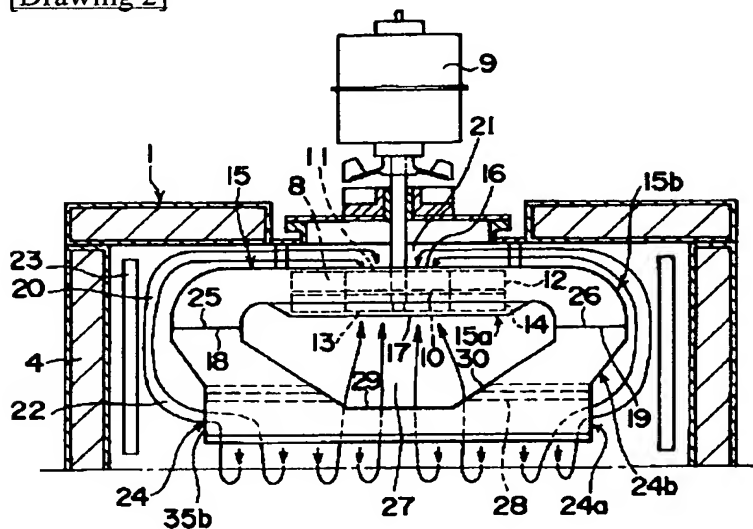
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## DRAWINGS

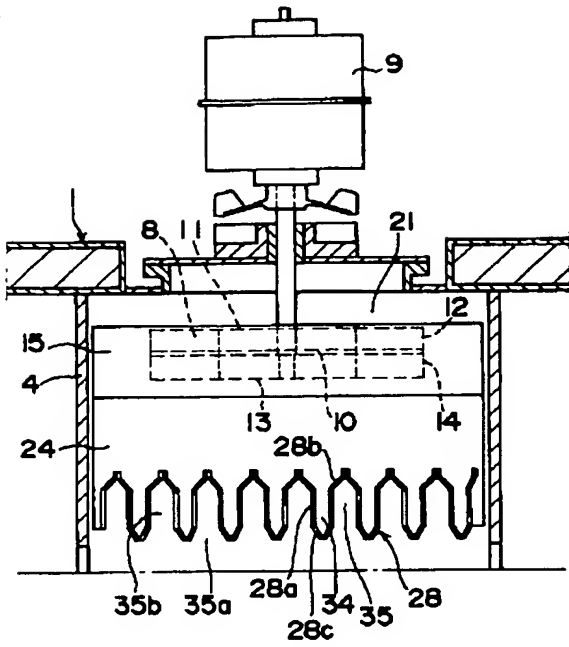
[Drawing 1]



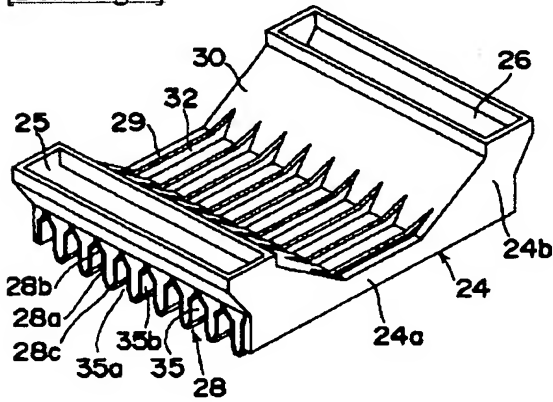
[Drawing 2]



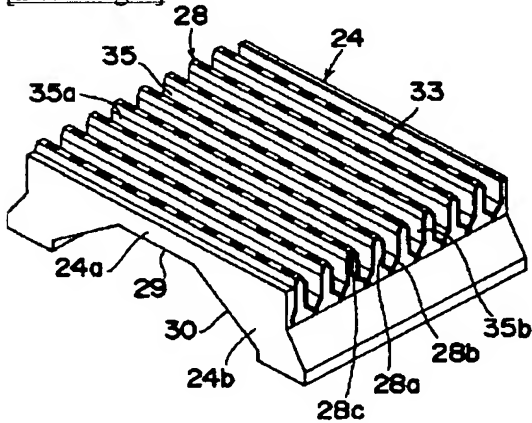
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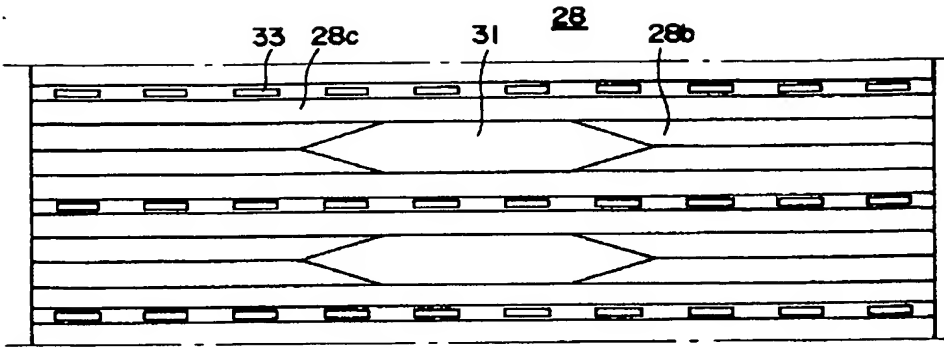
[Drawing 4]



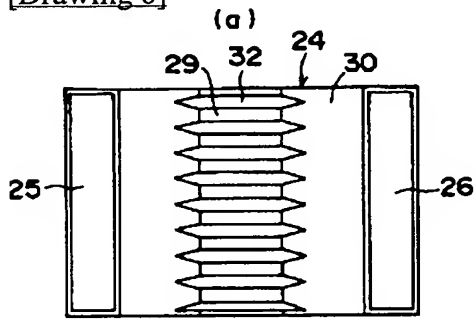
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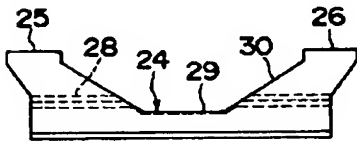
[Drawing 7]



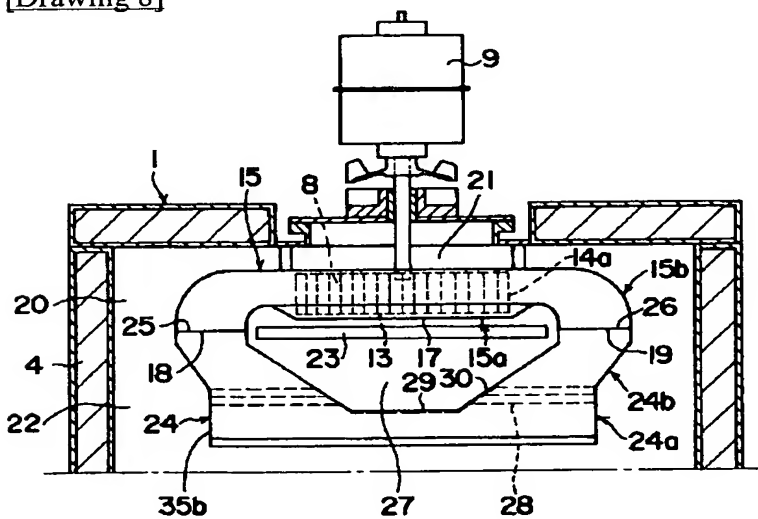
[Drawing 6]



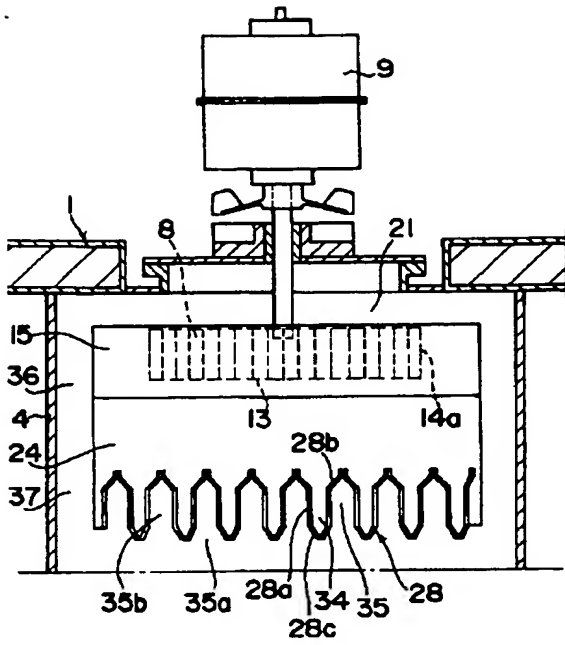
(b)



[Drawing 8]



[Drawing 9]



[Translation done.]



(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号  
特開2002-134905  
(P2002-134905A)

(43) 公開日 平成14年5月10日 (2002.5.10)

(51) Int.Cl.	識別記号	F I	テマコード(参考)
H 0 5 K 3/34	5 0 7	H 0 5 K 3/34	5 0 7 J 5 E 3 1 9
B 2 3 K 1/00	3 3 0	B 2 3 K 1/00	3 3 0 E
1/008		1/008	C
// B 2 3 K 101: 42		101: 42	

審査請求 有 請求項の数13 O L (全 8 頁)

(21) 出願番号 特願2000-279533(P2000-279533)  
(22) 出願日 平成12年9月14日(2000.9.14)  
(31) 優先権主張番号 特願2000-245501(P2000-245501)  
(32) 優先日 平成12年8月14日(2000.8.14)  
(33) 優先権主張国 日本(J P)

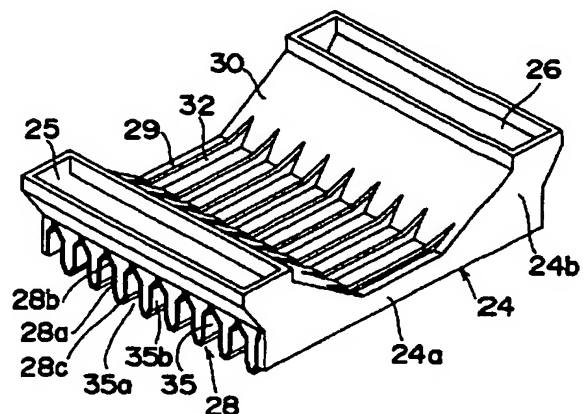
(71) 出願人 500379509  
有限会社ヨコタテクニカ  
東京都八王子市式分町437の11番地  
(72) 発明者 横田 八治  
東京都八王子市式分町437の11番地 有  
限会社ヨコタテクニカ内  
(74) 代理人 100085822  
弁理士 岡部 健一  
Fターム(参考) 5E319 AA03 AC01 BB05 CC36 CD29  
GG03

(54) 【発明の名称】 リフロー半田付け装置

(57) 【要約】

【課題】 電子部品を搭載した基板の加熱温度分布が均一になるように熱風の流れを円滑にしたリフロー半田付け装置を提供する。

【解決手段】 電子部品を搭載したプリント基板をコンベヤチェーンで搬送しながら加熱炉内で熱風を吹き付ける。熱風が流入する開口35aを基板に臨む側に有している通風路35が、基板に対向する面上にコンベヤチェーンの搬送方向に間隔をおいて複数設けられ、これらの通風路35に流入した熱風が通風路35の中間部に形成されている開口から送風機へ流れる第1の通路と、通風路35に流入した熱風が通風路35の両端面に形成されている開口35bから送風機へ流れる第2の通路とを有する。



## 【特許請求の範囲】

【請求項1】 加熱炉内を電子部品が搭載された基板をコンベヤで搬送しながら、循環する熱風を使用して電子部品を基板に半田付けするリフロー半田付け装置において、熱風が流入する開口を基板に臨む側に有している通風路が、基板に対向する面上にコンベヤの搬送方向に間隔をおいて複数設けられ、これらの通風路に流入した熱風が前記開口とは別に通風路の中間部に形成されている開口から送風機へ流れる第1の通路を有していることを特徴とするリフロー半田付け装置。

【請求項2】 前記通風路に流入した熱風が、通風路の端面に形成されている開口から送風機へ流れる第2の通路を有していることを特徴とする請求項1記載のリフロー半田付け装置。

【請求項3】 前記通風路が、コンベヤの搬送方向に交差する細長い通風路であることを特徴とする請求項1又は2記載のリフロー半田付け装置。

【請求項4】 基板に熱風を吹き付ける熱風の通風路が、前記熱風が流入する通風路の間に設けられていることを特徴とする請求項1、2又は3記載のリフロー半田付け装置。

【請求項5】 基板に熱風を吹き付ける熱風の通風路が、前記熱風が流入する各通風路の間に設けられていることを特徴とする請求項1、2又は3記載のリフロー半田付け装置。

【請求項6】 基板に熱風を吹き付ける熱風の通風路が、コンベヤの搬送方向に交差する細長い通風路であることを特徴とする請求項4又は5記載のリフロー半田付け装置。

【請求項7】 送風機は対向する両面に吸入口を有し、前記第1の通路を通る熱風は送風機の一方の吸入口に吸入され、前記第2の通路を通る熱風は送風機他方の吸入口に吸入されるように構成されていることを特徴とする請求項1～6のいずれかに記載のリフロー半田付け装置。

【請求項8】 送風機は基板側の面とその反対側の面とに吸入口を有し、前記第1の通路を通る熱風は、前記通風路の中間部に形成されている開口から送風機の基板側の面に設けられている吸入口に吸入され、前記第2の通路を通る熱風は、前記通風路の端面に形成されている開口から送風機の基板と反対側の面に設けられている吸入口に吸入されるように構成されていることを特徴とする請求項7記載のリフロー半田付け装置。

【請求項9】 送風機は一面に吸入口を有していることを特徴とする請求項1～6のいずれかに記載のリフロー半田付け装置。

【請求項10】 送風機は基板側の面に吸入口を有し、前記第1の通路を通る熱風は、前記通風路の中間部に形成されている開口から送風機の吸入口に吸入されるよう

に構成されていることを特徴とする請求項9記載のリフロー半田付け装置。

【請求項11】 送風機は基板側の面に吸入口を有し、前記第1の通路を通る熱風は、前記通風路の中間部に形成されている開口から送風機の吸入口に吸入され、前記第2の通路を通る熱風は、前記通風路の端面に形成されている開口から送風機の吸入口に吸入されるように構成されていることを特徴とする請求項9記載のリフロー半田付け装置。

【請求項12】 送風機がターボファン又はシロッコファンで構成されていることを特徴とする請求項1～11のいずれかに記載のリフロー半田付け装置。

【請求項13】 前記加熱炉内に窒素ガスが供給されていることを特徴とする請求項1～12のいずれかに記載のリフロー半田付け装置。

## 【発明の詳細な説明】

【0001】

【発明の属する技術分野】本発明は、加熱炉内を電子部品が搭載された基板をコンベヤで搬送しながら循環する熱風を使用して半田付けを行うリフロー半田付け装置に関する。

【0002】

【従来の技術】リフロー半田付け装置は、電子部品を搭載した基板をコンベヤチェーンで搬送しながら加熱炉内で加熱して、クリーム半田を溶融させ、電子部品を基板上に半田付けする装置である。

【0003】このリフロー半田付け装置には、送風機とヒータが配置されて熱風により電子部品をリフロー半田付けするものがある。この方式のリフロー半田付け装置は、一般に、複数の予備加熱室と1個のリフロー半田付け室をコンベヤチェーンの搬送方向に沿って順に有しており、各予備加熱室とリフロー半田付け室にはそれぞれ送風機とヒータが設けられている。送風機とヒータはコンベヤチェーンを挟んで上下に配置されており、送風機によってヒータを通して加熱された熱風が各室内に形成されている導風手段に導かれてコンベヤチェーン上の電子部品を搭載したプリント基板上に吹き付けられる。導風手段は、コンベヤチェーン上のプリント基板上に間隔をおいて水平に配置するノズル板を備えており、このノズル板に形成されている複数のノズル孔から熱風が電子部品を搭載したプリント基板上に吹き付けられる。

【0004】

【発明が解決しようとする課題】上記において、ノズル板のノズル孔からプリント基板の端部付近に吹き付けられた熱風は、プリント基板の端部付近を加熱した後、側方の空間部へ流出するので、常に所定温度に加熱された熱風がプリント基板の端部付近には吹き付けられる。しかしながら、ノズル板のノズル孔からプリント基板の中央部付近に吹き付けられた熱風は、プリント基板の中央部付近を加熱した後、側方の空間部へ流出しにくく、そ

の付近に滞留しがちである。その結果、プリント基板の端部付近と中央部付近で加熱温度に差異を生じ、加熱温度分布が不均一になる問題を有している。

【0005】本発明は、上記事情に鑑みてなされたものであり、電子部品を搭載した基板の加熱温度分布が均一になるように熱風の流れを円滑にしたリフロー半田付け装置を提供することを目的とする。

【0006】

【課題を解決するための手段】本発明は、上記の課題を解決するために、次の解決手段を採る。即ち、本発明は、加熱炉内を電子部品が搭載された基板をコンベヤで搬送しながら、循環する熱風を使用して電子部品を基板に半田付けするリフロー半田付け装置において、熱風が流入する開口を基板に臨む側に有している通風路が、基板に対向する面上にコンベヤの搬送方向に間隔をおいて複数設けられ、これらの通風路に流入した熱風が前記開口とは別に通風路の中間部に形成されている開口から送風機へ流れる第1の通路を有していることを特徴とする。

【0007】上記によれば、電子部品を搭載した基板に吹き付けられた熱風は、基板側に臨む開口から通風路内に流入し、通風路の中間部に形成されている開口から送風機へ円滑に流れる。

【0008】本発明は、上記第1の通路の他に、第2の通路を有しているのが好ましい。即ち、前記通風路に流入した熱風が、通風路の端面に形成されている開口から送風機へ流れる第2の通路を有しているのが好ましい。

【0009】上記によれば、電子部品を搭載した基板に吹き付けられた熱風は、基板側に臨む開口から通風路内に流入した後、上記第1の通路を通して送風機へ流れる他、通風路の端面に形成されている開口から送風機へ流れるので、熱風の循環をより円滑に行える。

【0010】前記通風路は、例えば、コンベヤの搬送方向に交差する細長い通風路として形成される。そして、基板に熱風を吹き付ける熱風の通風路は、前記熱風が流入する通風路の間、より好ましくは前記熱風が流入する各通風路の間に設けられるのがよい。その場合、基板に熱風を吹き付ける熱風の通風路は、例えば、コンベヤの搬送方向に交差する細長い通風路として形成される。

【0011】第1及び第2の通路を有する場合、送風機は対向する両面に吸入口を有し、第1の通路を通る熱風は送風機の一方の吸入口に吸入され、第2の通路を通る熱風は送風機他方の吸入口に吸入されるように構成するのが、熱風を円滑に循環させる構成上好ましい。

【0012】その場合、例えば、送風機は基板側の面とその反対側の面とに吸入口を有し、第1の通路を通る熱風は、前記通風路の中間部に形成されている開口から送風機の基板側の面に設けられている吸入口に吸入され、第2の通路を通る熱風は、前記通風路の端面に形成されている開口から送風機の基板と反対側の面に設けられて

いる吸入口に吸入されるように構成するのが好ましい。

【0013】対向する両面に吸入口を有する送風機は、1つの送風機として構成する他、2つの送風機を組み合わせて構成してもよい。

【0014】なお、送風機は上記のように二面に吸入口を有するのが好ましいが、一面に吸入口を有するものでもよい。

【0015】その場合、第1の通路を有する場合は、例えば、送風機は基板側の面に吸入口を有し、第1の通路を通る熱風は、前記通風路の中間部に形成されている開口から送風機の吸入口に吸入されるように構成するのが好ましい。

【0016】また、第1及び第2の通路を有する場合は、例えば、送風機は基板側の面に吸入口を有し、第1の通路を通る熱風は、前記通風路の中間部に形成されている開口から送風機の吸入口に吸入され、第2の通路を通る熱風は、前記通風路の端面に形成されている開口から送風機の吸入口に吸入されるように構成するのが好ましい。

【0017】送風機は例えばターボファン又はシロッコファンで構成される。両面に吸入口を有する送風機の場合、ターボファンであると、送風機の厚みを薄くできるので、好ましい。

【0018】加熱炉内は空気雰囲気でもよいが、窒素ガスが供給されるのが酸化防止の点で好ましい。

【0019】

【発明の実施の形態】以下、本発明の一実施形態を図1～図7に基づいて説明する。

【0020】リフロー半田付け装置は細長い加熱炉1を有している。加熱炉1内は電子部品及び半田の酸化を防止するために窒素ガスが供給されている。電子部品を搭載したプリント基板2はコンベヤチェーン3によって加熱炉1内を搬送される。

【0021】加熱炉1は、仕切り壁4で8個の室に仕切られており、7個の予備加熱室5と1個のリフロー半田付け室6とを搬送方向に沿って順に備えている。予備加熱室5は電子部品を搭載したプリント基板2を徐々に加熱するための室である。電子部品を搭載したプリント基板2は、この予備加熱室5で約150℃に加熱される。リフロー半田付け室6はクリーム半田を溶解し、電子部品を半田付けする室である。電子部品を搭載したプリント基板2は、このリフロー半田付け室6で約230℃に加熱される。また、冷却部7は半田付け後の高温状態にある電子部品を搭載したプリント基板2を冷却するための個所で、加熱炉1に隣接して設けられている。

【0022】コンベヤチェーン3は、往路は、加熱炉1の入口側から加熱炉1内の上下方向の略中央部を貫通し、加熱炉1の出口に隣接して配置されている冷却部7まで水平に配置され、復路は加熱炉1の下方に配置されている。1aは加熱炉1の入口壁と出口壁に形成されて

いる開口、4aは仕切り壁4に形成されている開口である。電子部品を搭載したプリント基板2は、加熱炉1の入口側でコンベヤチェーン3に載置され、コンベヤチェーン3によって加熱炉1内を移動した後、冷却部7を通り、その後、回収される。

【0023】加熱炉1の各室5、6にはコンベヤチェーン3を挟んで上下に同じ構造の熱風循環装置が設けられている。以下、上部側の装置について説明する。

【0024】加熱炉1の各室5、6の上端部にはそれぞれ送風機8が設けられており、加熱炉1の外の上面に設置された各モータ9に接続している。送風機8は鉄板10を挟んでその上下に羽根が配置され、上面に吸入口11、外周に吐出口12を有し、下面に吸入口13、外周に吐出口14を有している。送風機8はシロッコファンやターボファンで構成されるが、本実施形態ではターボファンで構成され、第1ケーシング15内に収納されている。

【0025】第1ケーシング15は送風機収納部15aと導風部15bとからなっている。送風機収納部15aは送風機8を収納し、送風機8の吸入口11、13に対向する上下面にそれぞれ吸入口16、17を有し、導風部15bは送風機収納部15aの左右開口部から左右に張り出して先端部が下方に湾曲して下方を向いた接続口18、19を有している。第1ケーシング15は平面視で矩形であり、仕切り壁4との間に殆ど隙間がないが、各室5、6の左右側面との間には空間部20があり、また、上面よりも少し下側に間隔をあけて配置されているので各室5、6の上面との間に空間部21が形成されている。そして、第1ケーシング15の側方の空間部20とその下の空間部22にはヒータ23が配置されている。ヒータ23の種類は特に問わないが、本実施形態ではシーズヒータが使用されている。

【0026】第1ケーシング15の下には第2ケーシング24が配置している。第2ケーシング24は通風路形成部材を収納するもので、本実施形態では通風路形成部材収納部24aと導風部24bとからなっている。通風路形成部材収納部24aは平面視で矩形のケースで下面が開放している。導風部24bは通風路形成部材収納部24aの左右端部に形成されている上面開口から上方に延び、上方を向いた接続口25、26を有しており、それらの接続口25、26に第1ケーシング15の接続口18、19が接続されている。第2ケーシング24は、仕切り壁4との間に殆ど隙間がないが、各室5、6の左右の側面との間には空間部22がある。

【0027】第2ケーシング24内には通風路形成部材28が収納されている。通風路形成部材28は板材を波形に屈曲した形状をなしており、コンベヤチェーン3の搬送方向に間隔をおいて平行に複数配列されている縦壁28aと、隣接する縦壁28aの上端を接続する断面略逆V字形の屋根壁28bと、隣接する縦壁28aの下

端を接続する断面略V字形のノズル形成壁28cとで形成され、屋根壁28bとノズル形成壁28cはコンベヤチェーン3の搬送方向に交互に形成されている。通風路形成部材28は、その上端が第2ケーシング24の中間部の水平な上面29よりも少し上方の位置に配置するようにして、第2ケーシング24内に収納固定されている。したがって、通風路形成部材28の中間部は屋根壁28bから縦壁28aの上端部にかけて第2ケーシング24の中間部の水平な上面29とその両側の導風部24bの傾斜面30に整合するように切欠され、細長い開口31を形成している。そして、複数の細長い開口31が臨んでいる第2ケーシング24の水平な上面29と傾斜面30にも同形状の細長い開口32が対応して複数形成されている。

【0028】ノズル形成壁28cの底面には長手方向に間隔をおいて複数のノズル孔33が形成されている。通風路形成部材28の縦壁28aで仕切られノズル孔33を有する細長い空間部が、電子部品を搭載したプリント基板2に熱風を吹き付ける熱風の通風路34を形成する。また、通風路形成部材28の縦壁28aで仕切られ屋根壁28bが臨む細長い空間部が、熱風が流入する通風路35を形成する。通風路形成部材28は第2ケーシング24の左右の側面部まで延びて第2ケーシング24の側面の下縁を形成しており、プリント基板2に熱風を吹き付ける通風路34の左右の端部は閉塞され、熱風が流入する通風路35の左右の端部は開口している。

【0029】以上は、コンベヤチェーン3の上側の熱風循環装置について説明したが、コンベヤチェーン3の下側の熱風循環装置も同じように構成されている。

【0030】次に、本発明の作用を説明する。

【0031】電子部品を搭載したプリント基板2は、加熱炉1の入口側でコンベヤチェーン3に載せられ、コンベヤチェーン3によって加熱炉1内を搬送される。加熱炉1の予備加熱室5とリフロー半田付け室6では、各室5、6内の送風機8がモータ9によって回転される。

【0032】以下、上側の熱風循環装置を基に説明する。

【0033】熱風は送風機8により第1ケーシング15の導風部15bを通して左右の接続口18、19から第2ケーシング24へ吐出される。第1ケーシング15の導風部15bから吐出された熱風は、第2ケーシング24の導風部24bから第2ケーシング24内に入り、通風路34のノズル孔33からコンベヤチェーン3上の電子部品を搭載したプリント基板2に吹き付けられる。

【0034】電子部品を搭載したプリント基板2に吹き付けられた熱風は、電子部品を搭載したプリント基板2を加熱した後、通風路35のプリント基板2に臨む側の開口35aから通風路35に流入する。そして、通風路35に流入した熱風は、第1の通路を通して、送風機8の下面の吸入口13に吸入されると共に、第2の通路を

通って、送風機 8 の上面の吸入口 11 に吸入される。即ち、本実施形態では、通風路 35 に流入した熱風は、通風路 35 の長手方向における中間部に設けられている開口 31 と第 2 ケーシング 24 の開口 32 を通って、送風機 8 の下方の空間部 27 に流出し、送風機 8 の下面の吸入口 13 に吸入される。一方、通風路 35 に流入した熱風は、通風路 35 の両端面に形成されている開口 35b から側方の空間部 22 に流出し、ヒータ 23 によって加熱されながら、上方の空間部 20 を通って第 1 ケーシング 15 の上方の空間部 21 に入り、送風機 8 の上面の吸入口 11 に吸入される。

【0035】そして、送風機 8 によって熱風が第 1 ケーシング 15 の導風部 15b から第 2 ケーシング 24 内へ吐出され、ノズル孔 33 から電子部品を搭載したプリント基板 2 に吹き付けられ、電子部品を搭載したプリント基板 2 が加熱される。

【0036】以上は、上側の熱風循環装置を基に説明したが、下側の熱風循環装置も同じように作用する。

【0037】以上の通り、電子部品を搭載したプリント基板 2 を加熱する熱風は、滞留することなく、円滑に循環するので、電子部品を搭載したプリント基板 2 の加熱温度分布が均一になる。

【0038】上記のようにして、電子部品を搭載したプリント基板 2 は予備加熱室 5 で徐々に加熱され、リフロー半田付け室 6 でクリーム半田が溶融され、電子部品がプリント基板 2 上に良好に半田付けされる。その後、この電子部品を搭載したプリント基板 2 は、加熱炉 1 から出て、冷却部 7 を通る間に温度が徐々に下げられ、回収される。

【0039】図 8 は本発明の別の実施形態を示す。本実施形態は送風機及びヒータの構成が上記実施形態と相違しており、他の構成は上記実施形態と同じである。

【0040】本実施形態における送風機 8 は、下面のみ吸入口 13 を有し、外周に吐出口 14a を有しているシロッコファンで構成されている。また、ヒータ 23 は送風機 8 の下方の空間部 27 に配置されている。

【0041】したがって、本実施形態において、上側の熱風循環装置を基にその作用を説明すると、送風機 8 は下面の吸入口 13 から熱風を吸入し、それらが上記実施形態と同じようにして、第 1 ケーシング 15 から第 2 ケーシング 24 内に入り、通風路 34 のノズル孔 33 からコンベヤチェーン 3 上の電子部品を搭載したプリント基板 2 に吹き付けられる。

【0042】電子部品を搭載したプリント基板 2 に吹き付けられた熱風は、電子部品を搭載したプリント基板 2 を加熱した後、通風路 35 のプリント基板 2 に臨む側の開口 35a から通風路 35 に流入する。そして、通風路 35 に流入した熱風は、第 1 の通路を通して、送風機 8 の下面の吸入口 13 に吸入される。即ち、通風路 35 に流入した熱風は、通風路 35 の長手方向における中間部

に設けられている開口 31 と第 2 ケーシング 24 の開口 32 を通って、送風機 8 の下方の空間部 27 に流出し、送風機 8 の下面の吸入口 13 に吸入される。

【0043】そして、送風機 8 によって熱風が第 1 ケーシング 15 の導風部 15b から第 2 ケーシング 24 内へ吐出され、ノズル孔 33 から電子部品を搭載したプリント基板 2 に吹き付けられ、電子部品を搭載したプリント基板 2 が加熱される。

【0044】以上は、上側の熱風循環装置を基に説明したが、下側の熱風循環装置も同じように作用する。

【0045】本実施形態においても、上記の通り、電子部品を搭載したプリント基板 2 を加熱する熱風は、滞留することなく、円滑に循環するので、電子部品を搭載したプリント基板 2 の加熱温度分布が均一になる。

【0046】図 9 は本発明の更に別の実施形態を示す。本実施形態は、基板加熱後の熱風が第 1 の通路の他、第 2 の通路を通して送風機 8 に吸入される点で、図 8 で説明した実施形態と相違する。他の構成は図 8 で説明した実施形態と同じである。

【0047】本実施形態では、第 1 ケーシング 15 及び第 2 ケーシング 24 と、各室 5、6 の左右側面との間に空間部 36、37 が存在するように構成してある。

【0048】したがって、本実施形態において、上側の熱風循環装置を基にその作用を説明すると、送風機 8 は下面の吸入口 13 から熱風を吸入し、それらが上記実施形態と同じようにして、第 1 ケーシング 15 から第 2 ケーシング 24 内に入り、通風路 34 のノズル孔 33 からコンベヤチェーン 3 上の電子部品を搭載したプリント基板 2 に吹き付けられる。

【0049】電子部品を搭載したプリント基板 2 に吹き付けられた熱風は、電子部品を搭載したプリント基板 2 を加熱した後、通風路 35 のプリント基板 2 に臨む側の開口 35a から通風路 35 に流入する。そして、通風路 35 に流入した熱風は、上記で説明したように、第 1 の通路を通して、送風機 8 の下面の吸入口 13 に吸入される。そして、本実施形態においては、通風路 35 に流入した熱風は、更に、第 2 の通路を通して、送風機 8 の下面の吸入口 13 に吸入される。即ち、通風路 35 に流入した熱風は、通風路 35 の両端面に形成されている開口 35b から側方の空間部 22 に流出し、第 1 ケーシング 15 及び第 2 ケーシング 24 と各室 5、6 の左右側面との間に形成されている空間部 36、37 から送風機 8 の下方の空間部 27 に入り、送風機 8 の下面の吸入口 13 に吸入される。

【0050】そして、送風機 8 によって熱風が第 1 ケーシング 15 の導風部 15b から第 2 ケーシング 24 内へ吐出され、ノズル孔 33 から電子部品を搭載したプリント基板 2 に吹き付けられ、電子部品を搭載したプリント基板 2 が加熱される。

【0051】以上は、上側の熱風循環装置を基に説明し

たが、下側の熱風循環装置も同じように作用する。

【0052】本実施形態においても、上記の通り、電子部品を搭載したプリント基板2を加熱する熱風は、滞留することなく、円滑に循環するので、電子部品を搭載したプリント基板2の加熱温度分布が均一になる。

【0053】なお、上記実施形態では、循環する熱風で半田付けを行うリフロー半田付け装置を示したが、本発明は熱風を使用することに加えて遠赤外線ヒータを併用するリフロー半田付け装置にも適用できることは言うまでもない。

【0054】

【発明の効果】以上説明したように本発明のリフロー半田付け装置によれば、電子部品を搭載した基板を加熱する熱風が、滞留することなく、円滑に循環するので、電子部品を搭載した基板の加熱温度分布が均一になり、良好な半田付けを可能にする。

【図面の簡単な説明】

【図1】本発明の一実施形態であるリフロー半田付け装置を示す縦断面図である。

【図2】搬送方向に直角に切った図1の要部縦断面図である。

【図3】搬送方向に沿って切った図1の要部縦断面図である。

【図4】第2ケーシング部分をノズル孔と反対側から見た斜視図である。

【図5】第2ケーシング部分をノズル孔側から見た斜視図である。

\*【図6】第2ケーシング部分を示し、(a)は平面図、(b)は正面図である。

【図7】通風路形成部材のノズル孔側の端面を示す拡大部分図である。

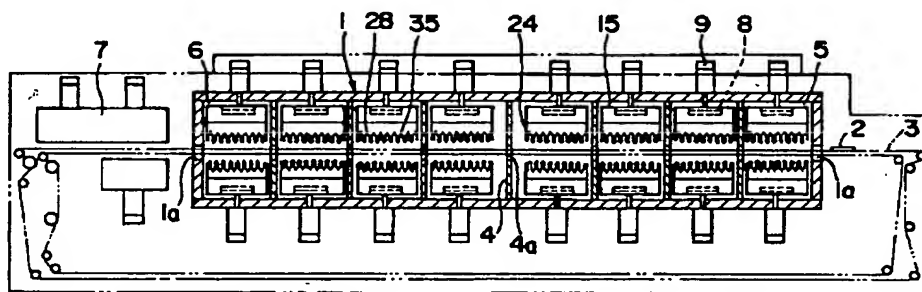
【図8】本発明の別の実施形態を示し、図2に対応する図である。

【図9】本発明の更に別の実施形態を示し、図3に対応する図である。

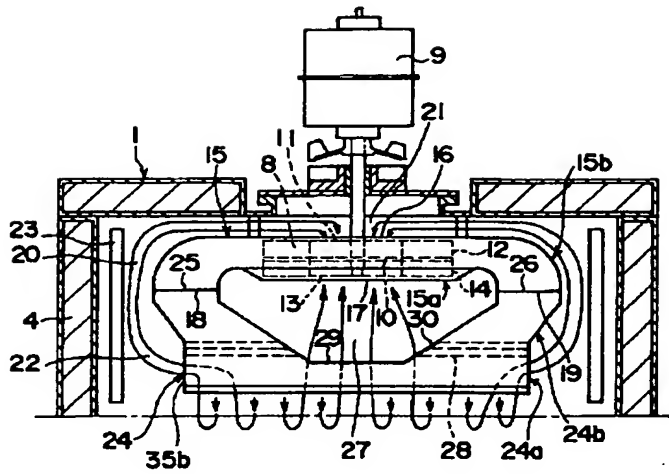
【符号の説明】

- 10 1・・・加熱炉、1a・・・開口、2・・・電子部品を搭載したプリント基板、3・・・コンベヤチェーン、4・・・仕切り壁、4a・・・開口、5・・・予備加熱室、6・・・リフロー半田付け室、7・・・冷却部、8・・・送風機、9・・・モータ、10・・・鉄板、11・・・吸入口、12・・・吐出口、13・・・吸入口、14、14a・・・吐出口、15・・・第1ケーシング、15a・・・送風機収納部、15b・・・導風部、16、17・・・吸入口、18、19・・・接続口、20、21、22・・・空間部、23・・・ヒータ、24・・・第2ケーシング、24a・・・通風路形成部材収納部、24b・・・導風部、25、26・・・接続口、27・・・空間部、28・・・通風路形成部材、28a・・・縦壁、28b・・・屋根壁、28c・・・ノズル形成壁、29・・・第2ケーシングの水平上面、30・・・第2ケーシングの傾斜面、31、32・・・開口、33・・・ノズル孔、34・・・基板に熱風を吹き付ける通風路、35・・・熱風が流入する通風路、35a、35b・・・開口、36、37・・・空間部。

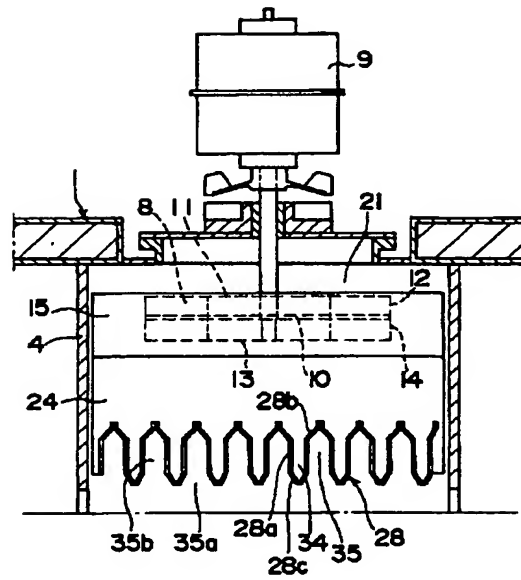
【図1】



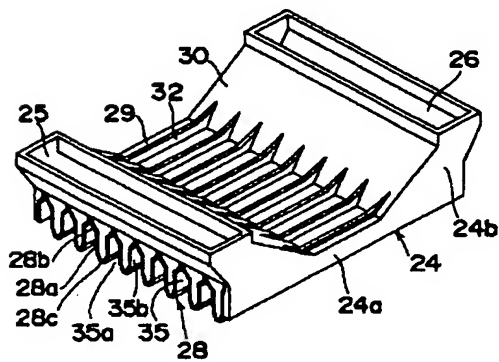
【図2】



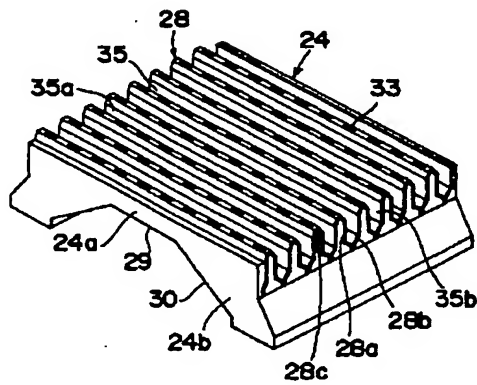
【図3】



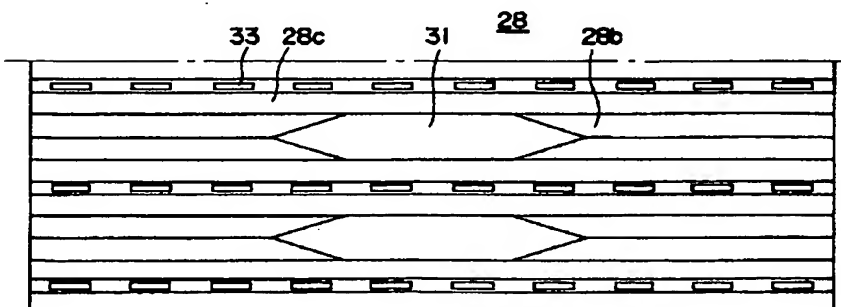
【図4】



【図5】

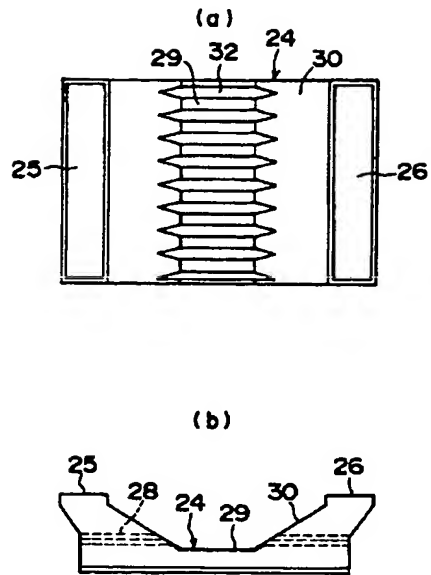


【図7】

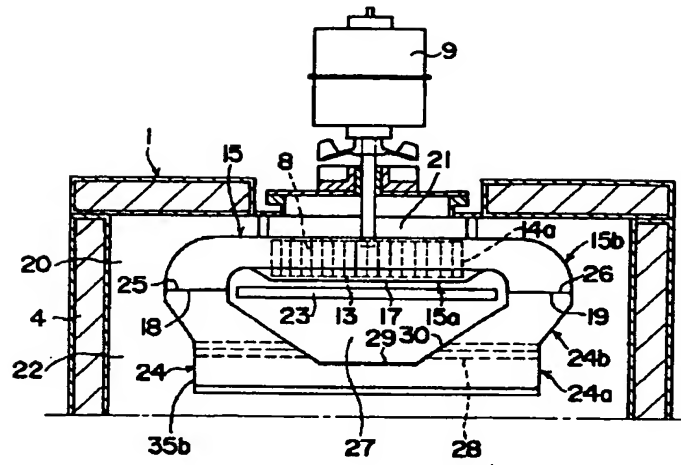




【図6】



【図8】



【図9】

